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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G06F 13/00

A1

(11) International Publication Number: **WO 99/01819**

(43) International Publication Date: 14 January 1999 (14.01.99)

(21) International Application Number: PCT/US98/13761

(22) International Filing Date: 30 June 1998 (30.06.98)

(30) Priority Data:
60/051,501 1 July 1997 (01.07.97) US

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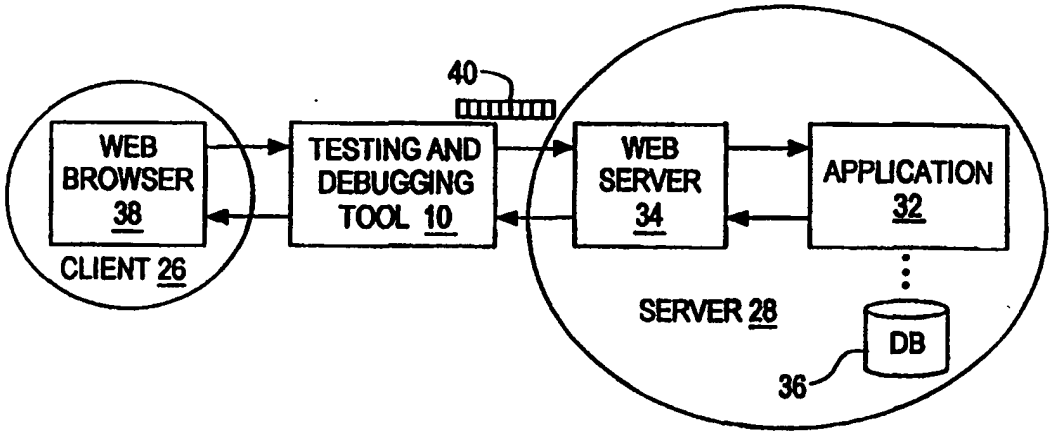
(81) Designated States: CA, JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: TESTING AND DEBUGGING TOOL FOR NETWORK APPLICATIONS



(57) Abstract

A software development tool (10) permits capture, modification and recording of transactional messages that are transmitted between a client (26) and a server (28) in a computer network. A proxy is employed to capture messages such as requests and responses that are in transit between the client (26) and the server (28). The captured requests and responses can be displayed and modified before being retransmitted via the proxy. Further, transaction records can be selectively provided to at least one software application (46) for analysis.

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TITLE OF THE INVENTION

TESTING AND DEBUGGING TOOL FOR NETWORK APPLICATIONS

CROSS REFERENCE TO RELATED APPLICATIONS

Priority is claimed to U.S. Provisional Patent Application Serial No. 60/051,501 entitled TESTING AND DEBUGGING TOOL, filed July 1, 1997.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable.

BACKGROUND OF THE INVENTION

The present invention is related to software development tools, and more particularly to testing and debugging tools for network applications.

Testing and debugging tools that facilitate software development are known. However, known testing and debugging tools are generally not well suited for use with network applications such as internet web sites. Testing and debugging tools are typically operative with only one programming language. However, the software employed by an internet web site and browser may comprise a plurality of programming languages. Testing and debugging tools are designed to be employed prior to deployment of the application under development. However, the behavior of a network application following deployment in a "real" environment is often different than the behavior of the application in the development environment.

BRIEF SUMMARY OF THE INVENTION

In accordance with the present invention, a software development tool permits capture, modification and recording of transactions between a client and a server in a computer network. The tool is situated in a communication path between the client and the server. A protocol-specific proxy is employed to capture data units that are associated with the transaction when the data units are transmitted between the client and the server. The transaction is displayed and optionally modified en route between the client and the server. Further, transaction records are selectively provided to at least one software application for analysis. The supported protocols may include TCP/IP protocols such as HTTP, FTP, SMTP, POP3 and IMAP4.

Selectively capturing and modifying data units between the client and the server enables useful features such as tracing and isolating transactions between the client and server. It is also possible to debug a deployed application, debug the internal interactions of a browser application by employing inbound and outbound streams, preview data units that the client device will receive from the server device, and set breakpoints and watch variables to selectively interrupt transactions. Advantages related to security and performance concerns about applets and components that instantiate in a browser application include enumeration of methods, fields and interfaces in a class prior to activation in the browser, enumeration of methods, properties and events in an ActiveX type library prior to activation in the browser, opening a CAB file prior to activation in the browser, and logging an "on-the-wire" transaction.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The foregoing features of this invention, as well as the invention itself, may be more fully understood from the

following Detailed Description of the Invention, and Drawing, of which:

Fig. 1 is a block diagram of the testing and debugging tool;

Fig. 2 is a block diagram that illustrates capture and modification of data units;

Fig. 3 is a block diagram that illustrates providing transaction records to selected applications;

Fig. 4 is a block diagram that illustrates use of the software development tool with an online shopping cart application;

Fig. 5 is a block diagram that illustrates use of the software development tool with a load testing application; and

Fig. 6 is a block diagram that illustrates use of the software development tool with an error testing application.

DETAILED DESCRIPTION OF THE INVENTION

U.S. Provisional Patent Application Serial No. 60/051,501 entitled TESTING AND DEBUGGING TOOL, filed July 1, 1997 is incorporated herein by reference.

Referring to Fig. 1, a testing and debugging tool 10 for network applications includes a main application 12 and a transaction logging application 14. The main application contains an editor 15 and a plurality of TCP/IP protocol proxies including an HTTP proxy 16, an FTP proxy 18, an SMTP proxy 20, a POP3 proxy 22 and an IMAP4 proxy 24 in the illustrated embodiment.

Referring to Fig. 2, the testing and debugging tool 10 is situated in a communication path between a selected client device 26 and a selected server device 28. The entire communication path, including the client 26, server 28 and testing and debugging tool 10, may exist on a single computer device or, as illustrated, on multiple computer devices and interconnecting media. The server device 28 is selected by specifying a DNS name or IP address that is associated with

the server device. The client device 26 is selected by specifying a DNS name or IP address that is associated with the client device. Alternatively, the source address of the client can be snooped from a request 29 that is transmitted from the client 26 to the server 28 via the testing and debugging tool 10. In a connection between the client 26 and the server 28, the IP address of the testing and debugging tool 10 is employed for communications from the client 16 to the testing and debugging tool 10, and the IP address of the server 28 is employed for communication from the testing and debugging tool 10 to the server 28. Similarly, the IP address of the testing and debugging tool 10 is employed for communications from the server 28 to the testing and debugging tool 10, and the IP address of the client 26 is employed for communications from the testing and debugging tool 10 to the client 26. The DNS name or IP address of the server 28 is not required for the HTTP protocol. A destination identifier is extracted from the requested URL when HTTP is employed. A specified 32-bit signed numeric value indicates the port which the testing and debugging tool monitors for a connection from the client 26.

In a passive mode, transactions are monitored by the testing and debugging tool 10 without interrupting transmission between the client 26 and the server 28. The monitoring function may include display of transaction records. In the illustrated embodiment, a representation of requests 29, responses 31, and both the IP address and DNS name that are being employed by the active proxy are displayed.

Transaction requests 29 and responses 31 can also be captured and modified in the passive mode. In particular, the captured data units may be modified and then transmitted to the original destination. In the illustrated embodiment, request 29 would be modified to provide request 33, which is transmitted to server 28. Similarly, response 31 would be modified to provide response 35, which is transmitted to client 26. The testing and debugging tool may be equipped

with an editor to facilitate modification of transactional data. Further, modifications can be automated for operation upon multiple transactions.

A breakpoint condition can be specified under which the tool will interrupt transactions. In the illustrated example, transactions such as requests and responses are monitored and logged in the passive mode until a breakpoint condition is satisfied. The tool then enters a break mode in which the triggering transaction is interrupted. The request or response that comprises the triggering transaction is then presented to the user for viewing and editing. The user can choose to remain in the break mode and intercept subsequent requests and responses, or exit the break mode and monitor transactions until another breakpoint condition occurs. If the breakpoint occurs during a request, a response can be composed with the tool and sent to the client, thereby circumventing the server. Breakpoints can be set to trigger upon receipt of a request, a response, a specified request method, a response to a specified request method, a request made to a specified host (a specified request or every request), a request made for a specified URL (a specified request or every request), a specified status code (in response to any method or to a specified method), a response containing a status code within a specified category (in response to any method or to a specified method), a specified message header present in a request or a response, a message header with a specified value present in a request or a response, a specified HTTP version in a request or a response, a malformed HTTP request, and a malformed HTTP response.

Stream filters 37 can be employed to restrict the flow of information between the client 26 and the server 28. When a filter is set, only transactions that satisfy the filter criteria are forwarded from the proxy to the specified destination. Transactions that do not satisfy the filter criteria are filtered out. For example, an HTTP filter such as "Transaction Type = GET AND File Type = IMAGE AND File

Size > 20000" filters out GET requests for any image file that is larger than 20,000 bytes. A message is displayed to indicate that the GET request had been made, but the request is not forwarded to the server 28. A POP3 filter such as "If Transaction Type = RETR Then Discard Attachments" strips any MIME or UU encoded attachments from incoming mail messages, and sends the text portion of the message to the mail application associated with the client. Stream filters 37 can be set based on any combination of file type, file size, file date/time, breakpoint criteria, and View Filters.

View filters 39 can be employed to control the amount of information that is displayed during monitoring. View filters 39 only limit what is displayed, and do not affect the flow of data between the client 26 and the server 28. For example, an HTTP view filter such as "Transaction Type = POST" will filter everything except POST requests from being displayed. View filters 39 are defined with the same command syntax that is used to create stream filters.

Referring to Fig. 3, copies of transactions are selectively provided to at least one software application 30 in an active mode. In particular, the transaction logging application 14 (Fig. 1) maintains a record of each transaction that is captured by the active proxy. The transaction record is maintained at least until a copy of the transaction record is transmitted to a predetermined application 30. Transaction records can be sent to multiple applications if desired. The applications perform functions such as analysis based on the transaction records.

Fig. 4 illustrates an implementation of the testing and debugging tool 10 for analysis of an online store application 32 that employs a "shopping cart." The online store application 32 is associated with a web server application 34 and a database 36, both of which are associated with server device 28. A web browser 38 operating on client device 26 is employed to access the online store. The testing and debugging tool 10 is situated in the communication path between the web browser 38 and the web

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/13761

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :G06F 13/00
US CL :395/200.76,200.33,200.47,200.49
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 395/200.76,200.33,200.47,200.49

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,331,642 A (VALLEY et al) 19 July 1994, col.3, lines 12-48, col. 5-7.	1,6-7,13-14
X,P	US 5,673,322 A (PEPE et al) 30 September 1997, col. 5-6, 10-13.	1-18
Y,P	US 5,727,159 A (KIKINIS) 10 March 1998, col.2-3,6-8.	1-18
A	US 4,720,850 A (OBERLANDER et al) 19 January 1988, see the whole reference.	1-18
A	US 5,706,507 A (SCHLOSS) 06 January 1998, see the whole reference.	1-18
A	US 5,708,654 A (ARNDT et al) 13 January 1998, see the whole reference.	1-18

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

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International application No.
PCT/US98/13761

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US 5,774,670 A (MONTULLI) 30 June 1998, see the whole reference.	1-18